



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

May 31, 2017

Attachment 4 – Simulator and Cockpit Evaluation

OPERATIONAL FACTORS / HUMAN PERFORMANCE

DCA17FA021

A. ACCIDENT

Operator: American Airlines
Location: Chicago O'Hare International Airport (KORD), Chicago, Illinois
Date: October 28, 2016
Time: 1430 Central Daylight Time (CDT)
Airplane: Boeing 767-300, N345AN, SN 33084

B. OPERATIONS GROUP

Shawn D. Etcher – Co-Chair
Operational Factors Division (AS-30)
National Transportation Safety Board (NTSB)
490 L'Enfant Plaza East, SW
Washington, DC 20594

Katherine A. Wilson – Co-Chair
Human Performance and Survival Factors
Division (AS-60)
National Transportation Safety Board
490 L'Enfant Plaza East, SW
Washington, DC 20594

John C. Chiros
Great Lakes Region Flight Standards
Federal Aviation Administration (FAA)
2300 E. Devon Ave.
Des Plaines, IL 60018

Laurence K. Abernathy
Fleet Captain
American Airlines
4601 Hwy 360 MD849GSW
Fort Worth, TX 76155

Gavin D. Tade
Deputy Chairman Safety
Allied Pilots Association (APA)
14600 Trinity Blvd. Suite 500
Fort Worth, TX 76155

Robert F. Aaron, Jr.¹
Senior Safety Pilot
The Boeing Company
1301 SW 16th Street
Renton, WA 98055

C. SUMMARY

On October 28, 2016, about 1430 Central Daylight Time, American Airlines flight 383, a Boeing 767-300, registration N345AN, experienced an uncontained engine failure on the No. 2 engine during the takeoff roll at Chicago O'Hare International Airport (ORD), Chicago, Illinois. The scheduled, domestic passenger flight, operated under the provisions of Title 14 CFR Part 121, had an intended destination of Miami International Airport (MIA), Miami, Florida. The 161 passengers and 9 crewmembers evacuated the aircraft via emergency evacuation.

¹ Captain Aaron attended all interviews via teleconference but was unable to attend, in person, any of the simulator or cockpit evaluations

D. FOLLOW-ON DAILY ACTIVITIES

On January 9, 2017, the Operational Factors and Human Performance group reconvened at the American Airlines Training Center in Fort Worth, Texas. The group conducted four interviews, which included the fleet captain, the Miami base chief pilot, and two check airmen.

On January 10, 2017, the group conducted simulator evaluations of various scenarios, conducted five interviews, which included a first officer that had flown with the accident captain prior to the accident, two captains that had flown with the accident first officer prior to the accident, and two check airmen. The group then reconvened, along with the Survival Factors group, at American Airlines maintenance hangar 4 to conduct an evaluation of various systems on an exemplar aircraft.

On January 11, 2017, the group reconvened at the American Airlines Training Center to complete follow-on notes.

E. SIMULATOR EVALUATION

Location: American Airlines, Dallas, TX

Date: January 10, 2017, at 0735 CST

Overall Objectives:

- Document simulator fidelity, systems and alerts (firebell, door open caution/warning, flight attendant call chime audibility)
- Document Rejected Takeoff (RTO) for right engine fire on the ground above 80 knots but prior to 120 with evacuation
- Document RTO for right engine first above 120 knots but before 130 with evacuation
- Document a blown tire
- Document known RTO characteristics for the accident airplane
- Replicate the accident flight departure and subsequent RTO
- Document any difference with airplane handling and indications if left engine failure
- Document any indication differences with B767 vs B757 (i.e. fire loop failures)

Aircraft: Boeing B767 simulator²

Airport: Chicago O'Hare (KORD) – Runway 28R

Participants:

Shawn Etcher (NTSB, Operations)
Katherine Wilson (NTSB, Human Performance)
John Chiros (FAA)
Larry Abernathy (American Airlines)
Gavin Tade (Allied Pilots Association)

Initial Simulator Setup:

² Able to accommodate all five group members in attendance

- Configuration:
 - Weight 299,499
 - Fuel 41360
 - ZFW 258,139
 - Stab 3.7
 - CG 19.9 PCT
 - V-speeds 134, 137, 142
 - Thrust setting 97.0
 - Flaps 15 degrees
- Weather:
 - KORD 281951Z 18011KT 10SM OVC250 16/11 A3004 RMK AO2 SLP175 T01610111
- Captain was pilot flying (PF); Co-pilot was pilot monitoring (PM)
- For this evaluation group members from American Airlines and APA were used as the pilot flying and pilot monitoring, respectively.
- Fuel freeze was utilized during the entire simulator evaluation in order to repetitively simulate the accident flight.
- All departure began at 2,500 feet down the runway
- All runs were conducted with motion unless noted otherwise. The simulator went on motion at 0750.
- All runs were video recorded
- Clearance was to climb to 5,000 feet above mean sea level (msl).

Run 1: Normal Departure with Engine Failure at V1

Procedure

- Normal V1 procedures (American SOP)
- Normal taxiout (not timed to accident flight) and procedures. Note: simulator system did not have KORD gate details available and utilized a generic airport; however, runway 28R was utilized with the correct length of runway and utilized a departure point about 2,500 feet down the runway, past the threshold to simulate the accident flight available runway.
- Engine rollback at V1 (134 Knots)
- Crew performed normal American Airlines procedure for engine failure at V1

	Notes
	<ol style="list-style-type: none"> 1. Takeoff was initiated at 0758 the maneuver concluded at 0803 at 2,000 feet above mean sea level. 2. Rotation was normal. 3. There were no audible alerts. 4. There was no abnormal vibration. 5. Thrust settings were 97.2 on the left and reducing throughout the maneuver on the right with settings 11.7 and below. The climb rate was about 600 feet per minute. 6. Crew requested from simulated ATC to stop their climb at 2,000 feet msl.

Run 2: RTO after 80 knots

Procedure

- Repositioned to hold short line for runway.
- Autobrake set to RTO
- Engine failure with engine seizure and no fire bell
- Crew performed RTO per American SOP

	Notes
	<ol style="list-style-type: none">1. Right engine seizure set at 90 knots.2. RTO began at 94 knots.3. Autobrakes used throughout and up to the stopping of the airplane on the runway.4. Runway length used from application of power until full stop on the runway was about 3,500 feet.5. Crew recognized within 4 knots the need to reject the takeoff.6. Vibration and swerving along the runway centerline was noted.7. No evacuation performed as there were no additional external cues to warrant an evacuation.

Run 3: RTO after 120 knots but prior to V1

Procedure

- Repositioned at intersection 2,500 feet from approach end of runway 28R
- Autobrake Set to RTO
- Simulated uncontained engine failure after 128 knots then a fire bell a few seconds after
- Crew performed RTO
- During rollout chime from cabin three times

	Notes
	<ol style="list-style-type: none">1. Following engine seizure aircraft swerved to the right of the runway centerline. Identified quickly.2. During RTO no right thrust reverser.3. During the event the fire bell only sounded once after RTO.4. Cabin attendant chime was audible when manually pressed on the control panel. Not a distraction.5. Aircraft used 7,500 feet of runway length and stopped near the end of the runway.6. Crew conducted the engine fire checklist.7. No evacuation performed, as there were no additional external cues to warrant an evacuation.

Run 4: Simulated Accident Event

Procedure

- Repositioned at intersection 2,500 feet from approach end of runway 28R
- Autobrake set to RTO
- V1 134 knots, failure set for 133 knots
- Engine failure as the initial onset with subsequent fire as the airplane decelerates
- Crew performed RTO
- Subsequent doors open after stop

	Notes
	<ol style="list-style-type: none">1. Engine failure occurred at 133 knots.2. RTO began at 136 knots with a maximum noted speed of 138 knots3. Crew utilized maximum braking.4. Fire bell sounded at 85 knots.5. Aircraft stopped with the nose of the airplane possibly just off the end of the runway.6. Doors simulated open about 20 seconds after aircraft stopped. Noted that the door alerts on the EICAS were quickly “pushed down” on the EICAS by further airplane alerts.7. Crew noticed door alerts sometime after they occurred.8. Crew conducted the evacuation checklist.

Run 5: Accident Event Scenario Beginning at 100 knots

Procedure

- Repositioned at intersection 2,500 feet from approach end of runway 28R
- Autobrake set to RTO
- V1 134 knots, failure set for 100 knots
- Engine failure as the initial onset with subsequent fire as the airplane decelerates
- Crew performed RTO
- Subsequent doors open after stop

	Notes
	<ol style="list-style-type: none">1. Engine failure occurred at 100 knots2. RTO began at 104 knots with a maximum noted speed of 106 knots3. Crew utilized maximum braking4. Fire bell sounded early during deceleration5. Doors simulated open about 20 seconds after aircraft stopped. Noted that the door alerts on the EICAS were quickly “pushed down” on the EICAS by further airplane alerts.6. Crew conducted the evacuation checklist

Run 6: Tire failure after 120 knots but before V1

Procedure

- Repositioned at intersection 2,500 feet from approach end of runway 28R
- Autobrake set to RTO
- V1 134 knots
- Tire failure at 127 knots
- 2 Left main tire failures

	Notes
	<ol style="list-style-type: none">1. Noticeable “clunking” on roll and slight swerve.2. No vibration observed.3. Crew continued takeoff.4. Crew asked which tire failed and it was unclear to them exactly which tire. They speculated the tire and the captain stated that he had to add a little right rudder. The captain further clarified that the rudder pressure was less than what he would have used for a 10 to 15 knot crosswind.

Run 6: Engine Fire/Severe Damage on the ground before V1 (LEFT Engine)

Procedure

- Repositioned at intersection 2,500 feet from approach end of runway 28R
- Autobrake set to RTO
- V1 134 knots
- Engine severe damage (left engine) at 120 knots

	Notes
	<ol style="list-style-type: none">1. Crew performed RTO about 124 knots.2. Noticeable vibration.3. EICAS screen quickly blanked during the RTO.

Run 7: Engine Failure on Right Engine, RTO and fire indications aircraft

- Repositioned at intersection 2,500 feet from approach end of runway 28R
- Autobrake set to RTO
- V1 134 knots
- Engine severe damage (right engine) at 120 knots

	Notes
	<ol style="list-style-type: none"> 1. Engine Seizure at 120 knots. 2. RTO began at 121 knots. 3. Max speed achieved was 123 knots. 4. Airplane swerved to the right. 5. During the deceleration, engine fire alert sounded. 6. Aircraft stopped prior to the end of the runway. 7. Crew began to perform engine fire checklist. 8. 19 seconds after aircraft stopped cabin doors opened. 9. Screen black out during Evacuation Checklist.

F. AIRCRAFT EVALUATION

Location: American Airlines Maintenance Hangar 4, Fort Worth, TX

Date: January 10, 2017 at 2152 CST

Overall Objectives:

- Document systems and cockpit alerts (firebell, flight attendant call chime audibility, evacuation signal)
- Photograph view of right wing and engine from first officer's station.
- Photodocument switch locations (fire handles, fuel cut off, depressurization panel, etc.)

Aircraft: Boeing B767 - N343AN

Participants:

Shawn Etcher (NTSB, Operations)
Katherine Wilson (NTSB, Human Performance)
John Chiros (FAA)
Laurence Abernathy (American Airlines)
Gavin Tade (APA)

1. Documentation from First Officer's station:

While seated in the first officer's seat in various seat positions, relative to the control column, the right wing tip was visible only when the occupant's head was pressed against the side cockpit window. With the right side cockpit window opened and with the field of vision shifted to approximately 8 inches outside the cockpit window the right engine was visible. For clarification, the right engine was not visible from within the cockpit with the windows closed and the right wingtip was visible from positions adjacent to the window.



Photo 1: View of Right Engine from approximately 8 inches outside right-hand cockpit window (OPS Group Chairman)

2. Cockpit Overhead Panel Switch Documentation

The overhead panel contained numerous lights and switches, including the evacuation switch, pressurization panel, cabin call lights, and entry door status light. During the evaluation, the evacuation switch was activated and the evacuation horn was audibly observed in the cockpit and the cabin. The horn was silenced, in the cockpit only, by pulling on the white “horn shutoff” switch located immediately to the right of the command switch.



Photo 2: Cockpit Evacuation Command Panel (OPS Group Chairman)



Photo 3: Cabin Altitude Control Panel (OPS Group Chairman)



Photo 4: Entry Doors Status Indicator (OPS Group Chairman)

3. Center Pedestal

The center pedestal was located between the two pilot seats and contained various switches and system interaction, including the “FIRE/OVT TEST” panel, radio panel, radio tuning unit, Fuel Cutoff Switch, and the interphone handset. The group operated the “FIRE/OVT TEST” switch in order to test the firebell and the illuminated handles and switches. During the test the group observed the fire handle for the left and right engine, the APU firehandle, the Fuel Cutoff Switches for both engines, and the cargo firebottle “ARM” illuminate. During the test, the firebell was audibly detected and sounded once every approximate 5 seconds. During the fire test the group utilized the door “1 L” interphone to chime the cockpit. The interphone chime was audibly observed during the fire test and was able to be distinguished from the firebell.

The group also tested the cockpit interphone handset. The handset consisted of a numerical keypad and a “reset” button located directly below the numerical keypad, when held with the numbers right side up. The handset also had a label affixed to it with seven preassigned two-digit numbers for various door stations, public address system, and a flight attendant alert. When the flight attendant alert two-digit number was entered, four-chimes were audibly detected in the cabin of the aircraft. It was also noted that following the dialing of any of the preset extensions the handset unit, the “RESET” button had to be depressed and released (or the interphone reseated in the cradle) in order to either redial the same extension, dial another extension, or make a public address to the cabin. It was also noted that the same occurred when attempting to contact the cockpit from a flight attendant station. The group utilized the door “1 L” handset and dialed the cockpit; however, in order to chime the cockpit numerous times in rapid succession the operator would have to press “RESET” between each attempt. The group also kept the door “1 L” handset out of the secure holder and attempted to contact the cockpit from the door “1 RC” station. In this

test, the chime was audibly observed in the cockpit. The group further made a public address to the cabin from the “1 L” handset and attempted to subsequently contact the cockpit from the door “1 RC” handset; however, no audible chime was observed in the cockpit.



Photo 5: Center Pedestal as viewed from the aft (OPS Group Chairman)



Photo 6: Firehandles and Fuel Cutoff Switch during Fire Test as viewed from Captain's Seat (OPS Group Chairman)

4. Cockpit Emergency Equipment

The group documented the emergency equipment available in the cockpit, as well as any other emergency equipment the flightcrew was responsible for using during an emergency. The cockpit fire extinguisher, crash axe, and PBE³ was located on the flight deck wall behind the first officer's seat and to the right of the cockpit jumpseat (when seated facing forward). The location was also immediately below the hat clips affixed to the wall for the pilot's hat. The megaphone was located in a cabinet, located in the forward galley. The cabinet door consisted of four other placards besides the megaphone placard. When the cabinet door was opened, various emergency and flotation equipment were observed. Removal of some of the equipment revealed the megaphone mounted on and towards the aft of a metal shelf frame that was mounted in the cabinet.

³ Personal breathing equipment

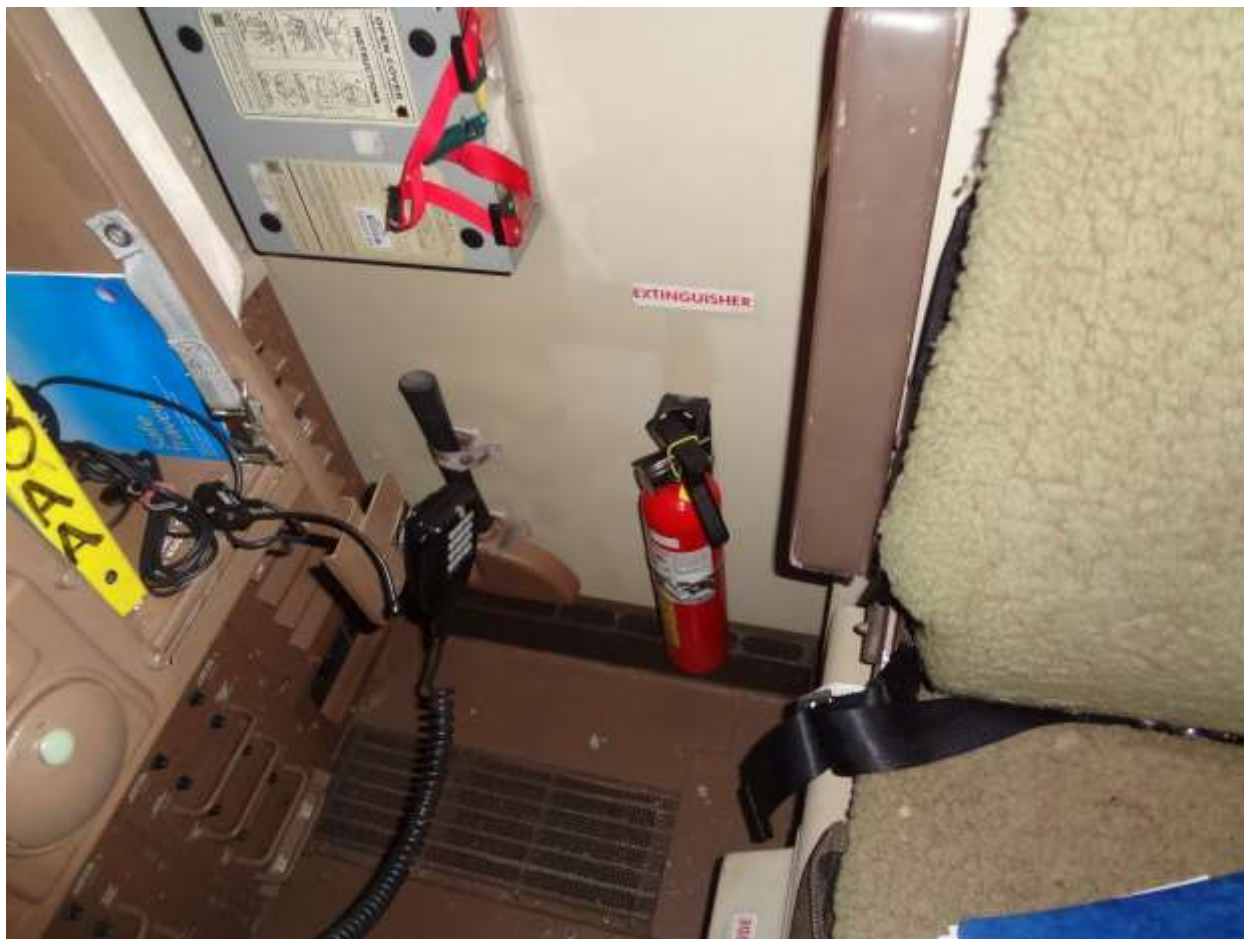


Photo 7: Cockpit Emergency Equipment (OPS Group Chairman)



Photo 8: Forward Galley Emergency Equipment Cabinet (OPS Group Chairman)



Photo 9: Cabinet as first viewed when cabinet door was opened (OPS Group Chairman)



Photo 10: Megaphone Mounted within the Cabinet (OPS Group Chairman)